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ABSTRACT

Little is known about the search strategy that employers use in their efforts to fill job vacancies. In this paper we analyse unique micro data to study this search strategy. We conclude that almost all vacancies are filled from a pool of applicants that is formed shortly after the posting of the vacancy. Hence, vacancy durations should be interpreted as selection periods and not as search periods for applicants.

Key words: Vacancies, employer search, vacancy duration.
JEL classification: 810, 210.

1. Introduction

In the past decade economists have made considerable progress in the study of unemployment durations. Firstly, search theory which has its roots in the 60's (Stigler (1961)) was developed into a coherent theoretical framework for models of unemployment spells[1)]. Secondly, the introduction of hazard models provided economists with the statistical tools that were needed to answer important questions concerning unemployment durations[2)]. These developments are closely related. On the one hand, job search theory predicts how the re-employment probability of an unemployed worker is affected by the constraints that he or she faces, e.g. the offer arrival rate, the wage offer distribution, the level of unemployment benefits, the (dis)utility of unemployment. On the other hand, hazard models of unemployment durations specify how the re-employment probability depends on characteristics of the unemployed worker and his/her environment and on the elapsed duration of unemployment. Ideally, an empirical hazard specification should be derived from a job search model. Usually empirical hazard models do not incorporate all the restrictions implied by job search theory[3)], but even reduced form hazard models are interpreted in the context of job search theory. Building realistic empirical models of job search which incorporate the restrictions of job search theory, and which allow for a direct test of this theory is still a major challenge.

The progress in the study of job search by the unemployed has not been matched by progress in the study of the search for employees by employers. This is unfortunate, because the performance of the labor market as measured by the rate at which matches between job seekers and searching employers are formed, can only be evaluated by considering both unemployment and vacancy durations (Jackman, Layard and Pissarides (1989) and Blanchard and Diamond (1989)). After the pioneering study by Holt and David (1966) surprisingly little work has been done on employer search. Barron and Bishop (1985) and Barron, Bishop and Dunkelberg (1985) study employer search by relating the number of applicants or interviews per employment offer and the time spent on recruiting and screening per applicant or per interview to characteristics of the vacancy and the employer. Their work can be seen as a direct study of various measures of the search intensity with which employers look for a suitable employee. They are silent on the outcome of the search effort, i.e. they do not study how long it takes to find a suitable employee and what are his or her characteristics. Beaumont (1978), Roper (1988), Renes (1989) and van Ours

(1989)[4] study vacancy durations, i.e. they only consider the outcome of the search effort of the employers. They relate the vacancy duration to various characteristics of the vacancy and the employer. Renes and van Ours who use hazard models also address the question how the rate at which vacancies are filled depends on the elapsed duration of the vacancy.

In this paper we shall use data on vacancy durations and the number of applicants to study the search strategy of employers. By combining these data we are able to separately identify the arrival rate of applicants and the acceptance probability of these applicants. We shall test whether the sequential search model that has been the dominant model for search by the unemployed, is an appropriate model for the recruitment behavior of employers. In the sequential search model applicants arrive sequentially at the firm and are accepted or rejected upon arrival. Such a model for employer search has been proposed by Lippman and McCall (1976) and other authors.

The plan of the paper is as follows. In section 2 we discuss models of employer search and compare them with models of search by the unemployed. In section 3 we introduce a model for the joint determination of vacancy durations and numbers of applicants. Section 4 describes the data, and the estimation results are in section 5. Section 6 concludes.

2. Vacancies and Employer Search

Firms have vacancies because it takes time to find a suitable employee for a specific job. Jobs usually require specific skills, and only some job seekers may have these skills. Moreover employers may need formal or informal tests to assess whether an applicant has the required skills. It takes time to attract applicants and to decide whether they are suitable. In most surveys a vacancy is defined as a slot that an employer would like to fill *immediately*. This implies that employers do not have perfect control over the hiring of new employees. They are faced with uncertainty over the time at which a suitable applicant can be hired, and over the characteristics of the new employee.

Of course, an employer can take measures to reduce this uncertainty. Most jobs have periods of notice which allow the employer to start searching and hiring before the present employee has left. This strategy is not very successful. In January 1988 68% of all vacancies in the Netherlands referred to unoccupied jobs (Central Bureau of Statistics, Vacancy Survey 1988)[5]. There may be a good reason for this. Advance hiring

of employees involves paying double wages, and this is an expensive way to avoid the costs of an unoccupied position. Advertising and using the services of a personnel department are other means to reduce the uncertainty regarding the time of hiring and the skills of the new employee. These efforts are quite effective. In the 80's the vacancy rate, i.e. the ratio of the number of vacancies to the number of employees, in the Netherlands varied between 0.4% in 1982 and 1.6% in 1988. In the same period the average complete vacancy duration varied between 2.1 months in 1980 and 0.9 months in 1983 (1988, 1.3 months)[6]. Hence, even if the employers have not full control over the time of hiring, they do not miss many employees due to vacancies, and new employees are not hired much later than planned. This does not mean that vacancies are uncommon: the number of vacancies generated in a year varied between 15% of the employed in 1987 and 5% in 1982. Hence, most jobs are presumably filled after a vacancy, i.e. at a later date than planned.

In the extensive literature on job search by the unemployed it is usually assumed that the unemployed use a sequential search strategy. Job offers arrive (or are discovered) according to a point process, e.g. a Poisson process. A job offer is a draw from a wage offer distribution. Upon arrival of the job offer the unemployed individual has to decide whether to accept the job or not. The optimal decision strategy maximizes the searcher's expected discounted utility stream. The optimal strategy depends on knowledge of the wage offer distribution and the arrival rate of jobs, the (non–)stationarity of the search environment, the form of the utility function, the possibility of recall (or not), and the time–horizon of the searcher. Under certain assumptions (e.g. known arrival rate and wage offer distribution, monotonic, additive utility, no recall, and infinite time–horizon) the optimal search strategy is characterized by a reservation wage. This reservation wage depends on the arrival rate, the search costs, and the parameters of the wage offer distribution. The probability that a randomly chosen job offer is acceptable depends on the same variables.

The probability that an unemployed job seeker finds a job in some small time interval, given that he or she is still unemployed at the start of that interval, i.e. the hazard rate of leaving unemployment (for a job), is equal to the product of the arrival rate of job offers and the acceptance probability.

We can build a similar model for search by employers, and indeed Lippman and McCall (1976, p.182) present such a model. A more sophisticated version of their Elementary Employer Search Model could be as follows.

Applicants arrive according to a Poisson process at a firm. The firm screens these applicants in order to assess their likely contribution to the firm's profits. Screening involves costs. There may also be costs if the vacancy refers to an unoccupied job. The firm knows the arrival rate of applicants (but not their time of arrival) and the distribution of characteristics of potential applicants. The productivity of applicants is not directly observable. Instead the firm may use observable characteristics as age, work experience and educational level as screening devices, possibly supplemented by further tests to assess the productive capacity of the applicant. The optimal strategy, i.e. the strategy that maximizes the expected present value of the flow of profits, specifies a reservation productivity or reservation values of observed productivity related characteristics, i.e. job requirements. These job requirements may also reflect the different productive skills required for heterogeneous jobs. In a companion paper (van Ours and Ridder (1990)) we analyze job requirements and their evolution over the duration of the vacancy.

In the sequential employer search model the hazard rate of filling a vacancy is equal to the product of the arrival rate of applicants and the probability that an applicant is acceptable. In our empirical work we shall use data on the number of applicants and the vacancy duration to identify both factors. The reservation wage (and hence the accepttance probability) depends on the arrival rate of offers: if the arrival rate increases, then the reservation wage also increases and the acceptance probability decreases. The effect of an increase in the arrival rate on the hazard rate can be either positive or negative[7].

The results of our analysis are not compatible with the sequential search model. Instead they indicate that employer search is non–sequential. Almost all applicants arrive in a short period just after the vacancy has been announced. Hence the firm seems to generate a large number of applicants early on in the vacancy duration. This is most likely the result of advertising the vacancy in one or more newspapers (69% of all vacancies are advertised, and 80% of these advertised vacancies are only advertised once) or notifying the labor exchange or an employment agency. There are good reasons why employers prefer this strategy. It is well–known that a compound strategy in which the searcher can generate more than one offer at some extra cost, usually dominates a sequential strategy where offers come one at a time (see Gal, Landsberger and Levykson (1981) and Morgan (1983)). Hence advertising and screening the resulting pool of applicants is preferred over sequential seach. Our results show that employers indeed use

this compound search strategy.

3. A Statistical Model of Vacancy Durations and the Number of Applicants

To study the recruitment strategy of employers we use data on the duration of a vacancy and the number of applicants that contacted the firm during this period. Hence we need the joint distribution of these random variables. We shall derive the model on the assumption of sequential search. However, if the true search strategy is non–sequential, the data are still compatible with a special case of our model. Hence, our model can be used to test whether employers use a sequential or a non–sequential strategy. We assume that applicants arrive at the firm according to a time–inhomogeneous Poisson process with arrival rate m(t). On arrival these applicants are tested by the firm, and immediately accepted or rejected. The probability that an applicant is suitable and is hired by the firm is equal to P(t). Thus the arrival rate of unsuitable applicants is equal to $m_R(t)=m(t)(1-P(t))$, and the arrival rate of suitable applicants, i.e. the rate at which the vacancy is filled or the hazard of filling the vacancy, is $m_A(t)=\theta(t)=m(t)P(t)$. The joint density of a vacancy duration t and N(t)=n rejected applicants at t is equal to

$$(3.1) \qquad f(n,t) = \theta(t)\exp\{-\int_0^t \theta(s)ds\}.\exp\{-M_R(t)\}\frac{(M_R(t))^n}{n!} \quad , \; n=0,1,...$$

with

$$(3.2) \qquad M_R(t) = \int_0^t m_R(s)ds$$

The density in (3.1) is written as the product of the marginal density of t and the conditional density of N(t) given the vacancy duration. Although this joint density is derived on the assumption of sequential search by the employers, we shall argue below that non–sequential search can be seen as a limiting case of this model.

The density in (3.1) is appropriate for the study of a cohort of vacancies. However, our data are obtained by sampling the stock of vacancies at a particular point in time. It is well–known (e.g. Ridder (1984)) that using density (3.1) in the analysis of stock data yields

biased estimates, e.g. the average vacancy duration is larger in the stock than in the cohort. The appropriate density for the analysis of durations drawn from the stock takes account of the overrepresentation of long durations in the stock.

Let us distinguish between calendar time τ and duration time t. Hence, if a vacancy that was posted at time τ has lasted a period t, then the calendar time is τ+t. The rate at which vacancies are announced is denoted by $q(\tau)$. This rate will vary with the calendar time. It is convenient to put the time-origin at the date that the stock was sampled. A vacancy can be included in the sample if was announced at some date -t and has lasted for at least a period t, i.e. if it still exists at the date of sampling. Hence, the density of an incomplete vacancy duration t_1 at time 0 is

$$(3.3) \qquad g_1(t_1) = \frac{q(-t_1)\exp\{-\int_0^{t_1}\theta(s)ds\}}{\int_0^{\infty} q(-t)\exp\{-\int_0^{t}\theta(s)ds\}dt}$$

The sample is not drawn from the stock of vacancies, but from the stock of firms. Only those firms were included that had a vacancy at the date of sampling. We can analyse this sample as a sample from the stock of vacancies, if we assume that vacancies are announced and filled independently of each other, i.e. there are no unobserved employer specific effects. In (3.3) we assume implicitly that the hazard θ does not depend on calendar time.

The joint density of the incomplete vacancy duration and the number of applicants at the date of interview is

$$(3.5) \qquad g_2(t_1,n) = g_1(t_1).\exp\{-M_R(t_1)\}\frac{(M_R(t_1))^n}{n!} \qquad , n=0,1,...$$

The firms that provided information in November-December 1986 were approached for a second interview after about 4 months. From this second interview we know whether the vacancy was filled in these 4 months and if so, when the vacancy was filled. If the date at which the vacancy was filled is given by t_2 (after a duration t_1+t_2), then it is easily seen that

$$(3.6) \qquad g_3(t_2|t_1,n) = \theta(t_1+t_2)\exp\{-\int_{t_1}^{t_1+t_2}\theta(s)ds\}$$

Hence, the joint density of t_1, t_2 and $N(t_1)$ is given by the product of (3.6) and (3.5).

4. The Data

The data were obtained by a stratified (by economic activity and number of employees) 5% random sample of all establishments in the Netherlands. Establishments with fewer than 10 employees were excluded, as were government agencies, educational institutions and employment agencies. The original sample of 2522 establishments resulted in a net sample of 1913 establishments who were willing to provide the relevant information. About a third (648) of these had one or more vacancies. Vacancies usually refer to job titles and not to individual jobs, e.g. a firm may have 4 vacancies (jobs) for computer operators (job title). In the questionnaire the vacancies were grouped by job title, i.e. we know the number of vacancies for that particular job title, but nothing about individual vacancies. This is appropriate for most purposes. However, as a consequence we do not know the incomplete vacancy duration if there is more than one vacancy for a particular job title. For this reason we exclude job titles with multiple vacancies. Depending on the number of job titles with vacancies the relevant information was gathered by telephone or by an interviewer who visited the establishment. This caused some additional non–response (68). All interviews were conducted in November–January 1986–1987.

The 580 establishments that cooperated in the first survey were approached again in March–April 1987. Almost all (550) establishments also participated in the second survey. In this second survey data were collected on the date at which vacancies were filled (if they were filled) and on the characteristics of the individuals who were hired. In the second survey the information was collected by vacancy and not by job title. At the time of the second survey 2547 of the 3608 vacancies in the first survey (71%) were filled.

For the reasons given above we have omitted all multiple vacancies. Our subsample consists of 670 vacancies. Of these 494 (74%) were filled at the time of the second survey. In Table 4.1 we give some characteristics of the vacancies in our sample. If we compare the sample means in Table 4.1 with those of a subsample of 1850 vacancies for which we have complete and reliable information, we find that our subsample contains more commercial and fewer industry jobs and that fewer vacancies are posted at the labor exchange. These differences are due to the elimination of all multiple

vacancies.

5. Estimation results

5.1 Reduced form analysis

As a first step we estimate a reduced form model for vacancy durations. In a reduced form model we do not attempt to identify the arrival rate and the acceptance probability. Instead we use a proportional hazard model for the hazard of the vacancy duration distribution. The hazard is specified as

$$\theta(t|x,v) = \exp\{\beta'x+\sum_{k=1}^{7}\lambda_k I_k(t)+v\} \tag{5.1}$$

In (5.1) time is measured in weeks, and $I_k(t)$, k=1,...,7 are time–varying dummy variables which are 1 in the time intervals 2–4 weeks, 1–2, 2–3, 3–4, 4–5, 5–6, 6+ months respectively. Hence, we have a flexible, piecewise constant hazard. The heterogeneity component v follows a discrete distribution with two points of support:

$$\begin{aligned} h(v_1) &= p \\ h(v_2) &= 1-p \end{aligned} \tag{5.2}$$

The points of support and the probability p are parameters to be estimated. We have to choose a particular normalization of the proportional hazard model in (5.1). We set the constant in (5.1) equal to 0. Moreover, we estimate v_1 and v_2-v_1 and we reparameterize p as $\exp\{\gamma\}/(1+\exp\{\gamma\})$.

The parameters of the model, $\beta,\lambda_1,...,\lambda_8,v_1,v_2-v_1,\gamma$ are estimated by maximum likelihood. In constructing the likelihood function we use the conditional distribution of the residual vacancy duration t_2 given the incomplete duration t_1, i.e. we use the conditional density in (3.6). An advantage of this conditional likelihood is that we only use the residual vacancy duration, which is likely to be more accurate than the incomplete vacancy duration. Moreover, by conditioning we eliminate the unknown entry rate $q(\tau)$. However, conditioning changes the heterogeneity distribution (5.2). It is intuitively clear that vacancies which have been open for a long time at the time of the first interview have on average a smaller v

than vacancies which were posted just before the time of the first interview. We can formalize this intuition by deriving the conditional density of v given t_1

$$(5.3) \qquad h(v_j|t_1,x) = \frac{\exp\{-\Theta(t_1|x)v_j\}p_j}{\sum_{k=1}^{2}\exp\{-\Theta(t_1|x)v_k\}p_k} \qquad j=1,2$$

with $p_1=p$, $p_2=1-p$, and

$$(5.4) \qquad \Theta(t_1|x) = \int_0^{t_1}\theta(s|x)ds$$

Hence, we have

$$(5.5) \qquad g(t_2|t_1,x) = \sum_{k=1}^{2} g(t_2|t_1,x,v_k)h(v_k|t_1,x)$$

There is one further complication. For some vacancies that were filled at the time of the second interview the exact date at which the vacancy was filled is not known. Hence, the likelihood contribution of a vacancy can take one of three forms:

$g(t_2\|t_1,x)$	if the vacancy is filled at a known date t_2
$\int_{T_2}^{\infty} g(s\|t_1,x)ds$	if the vacancy is open at T_2, the date of the second interview
$\int_{0}^{T_2} g(s\|t_1,x)ds$	if the vacancy is filled between 0 and T_2

The results are given in Table 5.1. Note that few regression coefficients are significant. Vacancies for commercial jobs are filled more easily than other vacancies. A higher level of education reduces the hazard. If the vacancy requires more experience it is filled at a slower rate.

Could these results be expected ? It is difficult to give a priori expectations of the signs of these coefficients. One can hypothesize that

employers try to control the duration of a vacancy and as a consequence will be choosy in filling a vacancy for which they expect many applicants. The opposite will hold for vacancies for which they expect few applicants. If this is correct, we expect that variables that increase the arrival rate of applicants, have a negative effect on the acceptance probability. Because the hazard rate is the product of the arrival rate and the acceptance probability, these effects may cancel, leaving the hazard rate (almost) unaffected. We need a structural model to disentangle the two effects.

The estimates show that there is positive duration dependence. More specifically, the hazard rate is small during the first two weeks, increases by 50% in the next two weeks, is multiplied by a factor 6.6 in the following month, and is doubled again in the subsequent period. Note also that there is strong evidence of unobserved heterogeneity. The 16% of the vacancies that correspond to v_2 have a hazard that is 1/16 of the v_1-type hazard. Neglecting this would cause a downward bias in the estimated regression coefficients (Ridder (1988)).

We also estimated a reduced form model for the number of (rejected) applicants at the date of the first interview. The likelihood is based on the conditional distribution of $N(t_1)$ given t_1 (see (3.5)). We also included unobserved heterogeneity as in (5.2), and we assumed that v is independent of t_1. The arrival rate of applicants is specified as

$$(5.6) \qquad \mu(t|x,v) = \exp\{\gamma'x+\sum_{k=1}^{4} J_k(t)+v\}$$

and the time-varying dummy variables $J_k(t)$, k=1,...,4 indicate 2–4 weeks, 1–2 months, 2–3 months and 3+ months. The results in Table 5.2 show that the arrival rate of applicants rises with the required level of education and decreases with the required experience. Part-time jobs and jobs which have been advertised attract more applicants. Establishments with a personnel department also have more applicants. The duration dependence in the arrival rate has an interesting form. It is large during the first two weeks, and jumps to zero after this first period, to increase slightly after two months. This implies that almost all applicants arrive during the first two weeks of the vacancy. Figure 5.1 shows that this conclusion could have been reached by inspection of the data. This observation has implications for the estimation and interpretation of the structural model of section 3.

5.2 A Structural Model of Vacancy Durations

In this section we shall consider the estimation of a structural model along the lines of section 3. In section 3 we assumed that the applicants arrived sequentially and that they were screened at the time of arrival, i.e. the employer accepted or rejected the applicant instantaneously. However applicants may not arrive sequentially and screening usually takes time. To be specific we assume that the employer advertises the vacancy and that this results in a pool of applicants of size N. These applicants arrive shortly after the advertisement. Next the employer screens these applicants and selects a suitable employee. Let us assume that it takes a period S to select this employee. This period may differ between firms. If employers use this strategy, then we expect that the arrival rate of applicants is large during the first weeks of the vacancy. Moreover, the acceptance probability is small, because it takes time to screen the applicants. In the subsequent weeks the arrival rate of applicants becomes small, and the vacancy hazard reflects the speed of selection of a suitable employee from the pool of applicants.

This interpretation is in line with the estimates of the duration dependence in the vacancy hazard and the arrival rate of (rejected) applicants: the rate at which applicants are hired is small during the first 4 weeks and the arrival rate of applicants becomes small after the first 2 weeks. In Table 5.3 we give these rates for the average vacancy, i.e. for the vacancy with the average characteristics of Table 4.1. To see the implications for the estimation of the duration dependence we note that the arrival rate of applicants in the structural model is equal to

$$m(t) = \theta(t) + \mu(t) \tag{5.7}$$

and the acceptance probability is equal to

$$P(t) = \frac{\theta(t)}{\theta(t) + \mu(t)} \tag{5.8}$$

From Table 5.3 we see that the estimated acceptance probability for the average vacancy is virtually 0 during the first 2 weeks, and is large during the next 2.5 months. The arrival rate of applicants is large during the first 2 weeks, is virtually 0 during the next 2 weeks, and gradually

increases during the next 2 months. After 3 months the arrival rate corresponds to a rate of about 2 applicants per month. These results are at odds with a sequential search model. They strongly suggest that employers use a non–sequential search strategy. Most applicants arrive in the first two weeks after the vacancy is posted. For the next 2.5 months few new applicants arrive. Hiring is intense during the second and the third month of the vacancy (32% and 36% of all vacancies are filled in these periods). After 3 months 76% of all vacancies are filled. Also after 3 months we observe an increase in the arrival rate of applicants to about 2 per month. The acceptance probability of these applicants is about .6. Almost all vacancies are filled by the fifth month.

We conclude that most vacancies are filled by applicants who arrived shortly after the beginning of the vacancy. The estimates also suggest that it takes 1–2 months to select a suitable new employee from the pool of applicants. The other 24% of the vacancies may be filled using a sequential search strategy. The relatively high acceptance probability guarantees that almost all vacancies are filled after 5 months.

In Table 5.4 we distinguish vacancies by the level of education that is required by the employers. Broadly the same picture emerges as for the average vacancy. Note that only 10% of all vacancies that require a lower vocational training are filled after the third month. This fraction is 20% and 28% for vacancies that require an intermediate or higher level of education. Note also that the initial pool of applicants is larger for vacancies that require a higher level of education. However, it takes more time to select a suitable employee from this pool. The acceptance probabilities show that the higher the required level of education the smaller is the fraction of acceptable applicants after 3 months. These results suggests that at the lower level employers need relatively little time to hire a suitable applicant from a relatively small initial pool, and that almost all employees are hired from this pool. At the higher educational level employers need more time to select a suitable employee from a larger pool of applicants. Fewer employees are hired from this pool which may be caused by relatively high standards in the evaluation of applicants at higher educational levels. These high standards are also used in evaluating applicants that arrive after the first three months, and this results in relatively small acceptance probabilities of these applicants.

Most empirical research of the search behaviour of the unemployed suggests that unemployment is due to lack of job offers. Our results show that vacancies are not the result of a lack of applicants. Most vacancies

are filled within 2.5 months after the arrival of a pool of applicants just after the beginning of the vacancy. Hence for most vacancies the vacancy duration is a selection period. If we thus reconsider the estimates of Table 5.1, we conclude that the selection period for commercial vacancies is relatively short, and that it takes more time to select a suitable employee if the required work experience is large and if the selection procedure includes a psychological test. From the second column of Table 5.1 we see that the length of the selection period decreases with the number of applicants, i.e. it takes less time to select an employee from a large pool of applicants than it takes to select an employee from a small pool of applicants. Because we have included a number of regressors that affect the number of applicants (see Table 5.2), we can interpret the coefficient as the effect of a deviation between the expected and the realized number of applicants. If the number of applicants is smaller than expected the employer may resort to sequential search which takes more time. Without information on the date of arrival of the successful applicant we can not investigate this possibility. However, this effect may explain the procyclical variation of the vacancy duration as documented in van Ours and Ridder (1989). In periods of high unemployment the large number of applicants reduces the average vacancy duration, and the opposite holds in periods of low unemployment.

Note that we can also reinterpret the estimates in Table 5.2. The Poisson model estimated in that table can be seen as a Poisson regression for the size of the initial pool of applicants.

6. Conclusion

It is tempting to treat unemployment and vacancies symmetrically: the unemployed are looking for a job, and firms with one or more vacancies are looking for employees. Our results show that search by the unemployed is different from search by firms. Employer search is mostly non–sequential. Employers advertise a vacancy, and thereby form a pool of applicants. Almost all applicants arrive shortly after the announcement of the vacancy and most vacancies are filled within the next 2.5 months, a period during which few new applicants arrive. After that period employers may resort to sequential search, but our data are not conclusive in this respect. Hence, most vacancies do not exist because there are no applicants, but because it takes time to select a suitable employee from the available applicants. In other words, vacancy durations are mostly selection periods, and modelling

vacancy durations means modelling the selection of an employee from a pool of heterogeneous applicants. In a companion paper (van Ours and Ridder (1990)) we pursue this point. More specifically, we study the role of job requirements in the selection process.

In the present paper we find that selection from a (unexpectedly) large pool of applicants is easier than selection from a (unexpectedly) small pool. Hence, if a given number of unemployed individuals searches with a low intensity we shall see few applicants and long selection periods (vacancy durations). This is in line with the finding of Jackman, Layard and Pissarides (1989) that the average vacancy duration has increased for a given level of unemployment (duration), because the unemployed search with a lower intensity. An alternative explanation is that employers now find it more difficult to select a suitable employee from the same number of applicants as before, because jobs have become more specialized. Without knowledge of the cyclical variation of the number of applicants we can not distinguish between these hypotheses.

Notes

1) Mortensen (1986) is an excellent survey of job search theory.

2) For an introduction into hazard models see Kiefer (1989).

3) Exceptions are Narendranathan and Nickell (1986) and Van den Berg (1990).

4) Renes (1989) and van Ours (1989) also use the OSA data.

5) It is interesting to note that this number is larger for small (<10 employees) firms, 74%, than for mediumsized (10–49 employees) and large (>49 employees), 65% and 46% respectively. Large firms have a more predictible outflow of employees and more possibilities for advance hiring. Note also that we report percentages of the stock of vacancies and that a larger fraction of the vacancies that are filled in a specific period may still be occupied at the time of hiring.

6) There is a substantial variation in these numbers with the required level of education and the type of job (van Ours and Ridder (1989)). Furthermore, the variation in the vacancy duration in relation to the variation in the unemployment duration may be more interesting than the order of magnitude (Blanchard and Diamond (1989), Jackman, Layard and Pissarides (1984)).

7) Van den Berg (1990) gives sufficient conditions for this effect to be positive.

References

Barron, J.M., and J. Bishop (1985), "Extensive Search, Intensive Search, and Hiring Costs: New Evidence on Employer Hiring Activity", *Economic Inquiry*, XXIII, pp. 363–382.

Barron, J.M., J. Bishop, and W.C Dunkelberg (1985), " Employer Search: The Interviewing and Hiring of New Employees", *Review of Economics and Statistics*, 67, pp. 43–52.

Berg, G.J. van den (1990), "The Effect of an Increase of the Rate of Arrival of Job Offers on the Duration of Unemployment", *Working Paper*, Department of Economics, University of Groningen.

Blanchard, O.J. and P. Diamond (1989), "The Beveridge Curve", *Brookings Papers on Economic Activity*, 1, pp. 1–76.

Devine, T.J. and N.M. Kiefer (1989), *Empirical Labor Economics in the Search Framework*, Manuscript, Cornell University.

Gal, S., M. Landsberger and B. Levykson (1981), "A Compound Strategy for Search in the Labor Market", *International Economic Review*, 22, pp. 597–608.

Holt, C.C. and M.H. David (1966), "The Concept of Job Vacancies in a Dynamic Theory of the Labor Market", in: *The Measurement and Interpretation of Job Vacancies*, NBER, New York.

Jackman, R., R. Layard and C. Pissarides (1989), "On Vacancies", *Oxford Bulletin of Economics and Statistics*, 51, pp. 377–394.

Kiefer, N.M. (1988), "Economic Duration Data and Hazard Functions", *Journal of Economic Literature*, 26, pp. 646–679.

Lippman, S.A. and J.J. McCall (1976), "The Economics of Job Search, a Survey", *Economic Inquiry*, 14, pp. 155–189, 347–368.

Morgan, P.B. (1983), "Search and Optimal Sample Sizes", *Review of Economic Studies*, L, pp. 659–675.

Mortensen, D. (1986), "Job Search and Labor Market Analysis", in: *Handbook of Labor Economics*, O. Ashenfelter and R. Layard eds., North–Holland, Amsterdam.

Nickell, S. (1986), "Dynamic Models of Labour Demand", in: *Handbook of Labor Economics*, O. Ashenfelter and R Layard eds., North–Holland, Amsterdam.

Ours, J.C. van, J.S. Hagens and A.M. de Voogd–Hamelink (1987), "Openstaande Vacatures onder de Loep Genomen", *OSA Working Paper V*19, OSA, The Hague.

Ours, J.C. van, and G. Ridder (1989), "An Empirical Analysis of Vacancy Durations and Vacancy Flows: Cyclical Variation and Job Requirements", *Working Paper no.* 325, Department of Economics, University of Groningen, to be published in: *European Economic Review.*

Ours, J.C. van, and G. Ridder (1990), "Job Requirements and the Recruitment of New Employees", in preparation.

Ours, J.C. van (1989), "Durations of Dutch Job Vacancies", *De Economist*, 137, pp. 309–327.

Renes, G. (1989), "Vacancy Durations: Shortages and Surpluses on the Labor Market", *Working paper*, Center for Research in Public Economics, University of Leiden.

Ridder, G. (1986), "The Sensitivity of Duration Models to Misspecified Unobserved Heterogeneity and Duration Dependence", *Working Paper*, University of Amsterdam.

Stigler, G. (1961), "The Economics of Information", *Journal of Political Economy*, 69, pp. 213–225.

Table 3.1. Sample means of some vacancy characteristics.

	N=496 Filled at 2nd survey	N=174 Open at 2nd survey	N=670 Total
Type of job:			
Commercial[1)]	.48	.27	.42
Industry[2)]	.23	.31	.26
Required education (minimal level):[3)]			
LBO	.23	.16	.21
MBO	.42	.36	.41
HBO/University	.29	.51	.34
Required experience:			
Minimal experience (years/10)	1.45	2.08	1.62
Recruitment channels (at 1st interview):			
Advertisement	.59	.58	.59
Labor exchange notified	.31	.34	.31
Job characteristics:			
Psychological test	.25	.39	.29
Part–time job	.09	.05	.08
Characteristics of establishment:			
Number of employees(/1000)	.39	.50	.44
Personnel department	.65	.66	.65
Vacancy duration:			
Incomplete duration at first interview (months)	1.82	2.53	2.01
Number of applicants:			
Number of applicants at first interview	12.1	8.04	11.1

1) Service, clerical or commercial job, Central Bureau of Statistics (CBS) job classification codes 3,4,5.
2) Industry job, CBS job classification codes 6,7.
3) Types of education (no. of years needed for graduation):
LBO: Lower vocational and lower level general education (9)
MBO: Intermediate vocational and intermediate general education (12)
HBO/University: Higher vocational education and university (15/18)

Table 5.1. *Parameter estimates reduced form model vacancy hazard (standard errors)*

Type of job:				
Commercial	.41	(.128)	.40	(.129)
Industry	−.30	(.188)	−.33	(.193)
Required education (minimal level):				
Lower vocational	.16	(.251)	.14	(.256)
Intermediate vocational	−.19	(.260)	−.22	(.265)
Higher vocational/ university	−.38	(.283)	−.40	(.288)
Required experience:				
Minimal experience (months/10)	−.11	(.042)	−.11	(.043)
Recruitment channels (at 1st interview):				
Advertisement	.17	(.105)	.13	(.107)
Labor exchange notified	−.090	(.118)	−.091	(.120)
Job characteristics:				
Psychological test	−.28	(.128)	−.28	(.130)
Part–time job	.023	(.192)	.019	(.193)
Characteristics of establishment:				
Number of employees (/1000)	−.048	(.075)	−.036	(.076)
Personnel department	.011	(.117)	−.008	(.118)
Duration effects:				
2–4 weeks	.46	(.905)	.41	(.893)
1–2 months	1.91	(.872)	1.84	(.851)
2–3 months	2.71	(.919)	2.69	(.908)
3–4 months	2.78	(.927)	2.78	(.919)
4–5 months	2.95	(.929)	2.87	(.921)
5–6 months	3.05	(.931)	3.07	(.922)
6+ months	2.59	(.930)	2.61	(.921)
Heterogeneity:				
v_1	−2.33	(.933)	−2.34	(.918)
v_1−v_2	−2.80	(.396)	−2.78	(.375)
γ	−1.59	(.529)	−1.46	(.473)
Applicants: Number of applicants(/10)	–		.032	(.014)

Table 5.2 *Parameter estimates reduced form model applicant arrival rate (standard errors)*

Type of job:		
Commercial	.45	(.041)
Industry	.22	(.047)
Required education (minimal level):		
Lower vocational	.53	(.102)
Intermediate vocational	.73	(.099)
Higher vocational/ university	.73	(.104)
Required experience:		
Minimal experience (months/10)	−.027	(.012)
Recruitment channels (at 1st interview):		
Advertisement	.91	(.056)
Labor exchange notified	−.053	(.041)
Job characteristics:		
Psychological test	−.034	(.039)
Part–time job	.36	(.052)
Characteristics of establishment:		
Number of employees (/1000)	−.057	(.027)
Personnel department	.51	(.039)
Duration effects:		
2–4 weeks	−6.76	(3.04)
1–2 months	−5.48	(2.45)
2–3 months	−4.09	(1.56)
3+ months	−3.01	(.183)
Heterogeneity:		
v_1	.68	(.108)
v_2−v_1	−1.89	(.029)
γ	−1.15	(.096)

Table 5.3 *Vacancy hazard and arrival rate of rejected applicants of 'average' vacancy; implied acceptance probability, applicant arrival rate, fraction of vacancies remaining, and probability of hiring.*

Time period	$\theta(t)$	$\mu(t)$	P(t)	m(t)	S(t)[1)]	f(t)[2)]
0–2 weeks	.0163	3.89	.004	3.91	–	.03
2–4 weeks	.0258	.00451	.85	.0303	.97	.05
1–2 months	.107	.0162	.87	.123	.92	.32
2–3 months	.233	.0651	.87	.298	.60	.36
3–4 months	.250	.192	.57	.442	.24	.15
4–5 months	.268	.192	.58	.460	.09	.06
5–6 months	.327	.192	.63	.519	.03	.02
6+ months	.205	.192	.52	.397	.01	.01

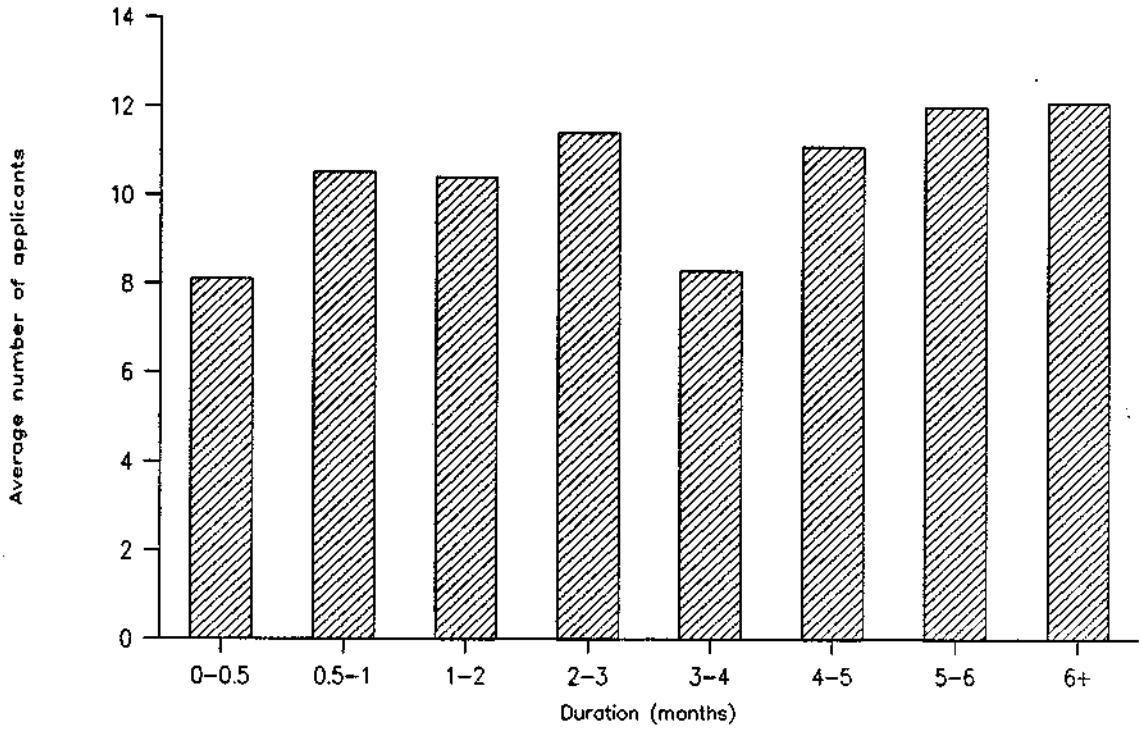
1) Fraction of 'average' vacancies remaining in indicated period.

2) Fraction of 'average' vacancies filled in indicated period.

Table 5.4 *Applicant arrival rate, acceptance probability, vacancies remaining, and probability of hiring by minimally required level of education.*

Time period	0–2	2–4	1–2	2–3	3–4	4–5	5–6	6+
$m(t)$								
Lower voc.	3.44	.0401	.168	.400	.537	.605	.650	.473
Interm. voc.	4.19	.0305	.126	.313	.467	.479	.511	.385
Higher voc./ university	4.18	.0254	.105	.265	.416	.454	.480	.379
$P(t)$								
Lower voc.	.007	.90	.92	.86	.69	.72	.74	.64
Interm. voc.	.004	.84	.87	.78	.46	.65	.67	.56
Higher voc./ university	.003	.81	.84	.74	.50	.55	.57	.46
$f(t)$								
Lower voc.	.04	.07	.43	.36	.08	.02	.00	.00
Interm. voc.	.03	.05	.34	.38	.13	.05	.02	.00
Higher voc./ university	.03	.03	.30	.36	.17	.07	.03	.01

Figure 5.1 *Number of applicants at first interview by incomplete vacancy duration.*



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